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A-F/1712

TRANSMITTAL OF APPEAL BRIEF (Large Entity)

Docket No.
END919990060US1

In Re Application Of: **Konstantinos Papathomas**

Serial No.	Filing Date	Examiner	Group Art Unit
09/781,631	**2/12/2001**	**Margaret G. Moore**	**1712**

Invention: **UNDERFILL COMPOSITIONS**

TO THE ASSISTANT COMMISSIONER FOR PATENTS:

Transmitted herewith in triplicate is the Appeal Brief in this application, with respect to the Notice of Appeal filed on

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DLB

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Dated: **5/19/03**

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Serial No. **09/781,631**	Filing Date **2/12/2001**	Examiner **Margaret G. Moore**	Group Art Unit **1712**

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re patent application of:	) Art Unit: 1712
Konstantinos Papathomas	) Examiner: Margaret G. Moore
Serial No.: 09/781,631	) Date: May 19, 2003
Filed: February 12, 2001	) Atty. Docket No.:) END919990060US1
For: UNDERFILL COMPOSITIONS	)

APPEAL BRIEF

Honorable Commissioner of Patents and Trademarks

Washington, DC 20231

S I R:

This Appeal is taken from the FINAL REJECTION of claims 31 through 70 as presented in the Office Advisory Action of February 21, 2003 (Paper No. 8) in the above-identified patent application, and the Office Action of October 18, 2002 (Paper No. 6).

REAL PARTY IN INTEREST

The real party in interest hereto is Appellant's Assignee, International Business Machines Corporation.

RELATED APPEALS AND INTERFERENCES

This appeal is the first appeal before the Office.

STATUS OF THE CLAIMS

All of the presently pending claims 31 through 70 now stand FINALLY REJECTED as of October 18, 2002 (Paper No. 6), which was reaffirmed in the Advisory Action of February 21, 2003 (Paper No. 8).

The rejection of claims 31 through 70 is hereby appealed.

STATUS OF THE AMENDMENTS

A first Office Action was mailed on April 4, 2002 (Paper No. 3). An amendment was filed on July 22, 2002. An Office Action FINALLY REJECTING claims 31 through 70 was mailed on October 18, 2002 (Paper No. 6). An Amendment was filed on

January 27, 2003. An Office Advisory was mailed on February 21, 2003 (Paper No. 8). A notice of appeal was filed on March 19, 2003.

SUMMARY OF THE INVENTION

The silica-filled encapsulant and its method of encapsulating an integrated circuit chip using flip-chip-attach techniques has been designed to function as a substance that is used between an integrated circuit chip and a ceramic or organic substrate. FCA encapsulants are currently used on ceramic substrates. The present invention includes the use of organic substrate materials. For organic substrates, the pre-cure viscosity of the encapsulant must be low. The organic substrate poses particular problems for an encapsulant because they absorb more moisture, are softer, and bend under thermal stress, as compared to ceramics.

The coefficient of thermal expansion (CTE) must be approximately three times that of ceramic materials (i.e., 20 ppm/°C vs. 6.5 ppm/°C). The higher CTE causes a great mismatch between chip and ceramic substrate, requiring the encapsulant to be tougher in withstanding thermal cycling. The inventive compositions increase the required toughness up to fifty percent without excessive change to viscosity and glass transition temperature. The silica-filled encapsulant

generally comprises, in composition by weight: 14 to 25 percent cycloaliphatic epoxy resin, 14 to 25 percent methyl-hexahydrophthalic anhydride, 0 to 2 percent aliphatic polyol, and less than 1 percent 2-ethyl-4-methylimidazole.

ISSUES

Claims 35, 36, 54, 56, and 66 have been rejected under 35 U.S.C. §112 for containing subject matter not described in the specification. Claims 41 and 42 through 51 have been rejected under 35 U.S.C. §112 for containing subject matter which was not described in the specification in an enabling manner. Claims 41 and 43 through 48 have been rejected under 35 U.S.C. §112 as being indefinite. Claims 37, 54, 57, 58, 67, and 68 are objected to under 37 C.F.R. §1.75(c) as having improper dependent form. Claims 31 to 33, 35, 37, 38, 42, 45, and 46 have been finally rejected over TANG et al. as anticipated under 35 U.S.C. §102(e). Claims 34, 36, 39, 40, 41, 43, 44, and 47 through 70 have been rejected under 35 U.S.C. §103(a) as being obvious over TANG et al. Claim 41 has been rejected under 35 U.S.C. §102(e) as anticipated by or obvious under 35 U.S.C. §103(a) over USUI et al. Claims 52, 54 through 56, 62, and 64 through 66 have been rejected under 35 U.S.C. §103(a) as unpatentable over USUI et al. Claims 42 through 44, and 46 have been rejected under 35 U.S.C. §102(b) as anticipated by HANYU et al. Claims 43, 45, and 47 through 51 have been

rejected under 35 U.S.C. §103(a) as unpatentable over HANYU et al.

GROUPING OF THE CLAIMS

The claims cannot be grouped together, taking into account that claims 31 through 35 recite physical attributes of the flip-chip-attach encapsulant composition for an organic or ceramic substrate, claims 36 through 51 describe encapsulant composition components by weight, and claims 52 through 70 recite a method of encapsulating an Integrated Circuit chip and an organic substrate only. The diversity of the claims requires separate consideration and grouping.

ARGUMENT

The Honorable Board is respectfully requested to reverse the rejection to claims 31 through 70. Appellant appreciates the thorough review by the Office, but sincerely believes that the rejections in their multiplicity are unwarranted for the following reasons:

1. Claims 35, 36, 54, 56, and 66 have been rejected under 35 U.S.C. §112 for containing subject matter not described in the specification. The Office claims that with

reference to claims 35, 56, and 66, there is no support in the specification, for example, for cyanate esters and epoxy polyimides on pages 3 and 4 of the specification. The Office failed to observe that these substances are specified at the top of page 4 as incorporated by way of reference to U.S. Patent No. 6,106,891, assigned by Kuleska et al. to IBM. The desired percentage of 0 to 2 percent is recited at the top of page 5. Claim 54 is rejected based on the fact that the Office finds no limitation as applied to a ceramic substrate, but claim 52 from which claim 54 depends, calls for an organic substrate, not a ceramic substrate.

2. Claims 41, and 42 through 51 have been rejected under 35 U.S.C. §112 for containing subject matter that was not described in the specification in an enabling manner. The basis of these claims can find support on page 11 of the specification. The claims have a typo: 2,500 should read 1,500.

3. Claims 41 and 43 through 48 have been rejected under 35 U.S.C. §112 as being indefinite. The Office claims that the specification is non-enabling because Appellant fails to describe how the toughness values were measured. It is well known in case law that a patent does not have to be a blueprint type specification. Appellant is allowed to recite the results of his testing without having to recite the particulars of the machines or engineering methods used to

obtain a toughness result. On page 11, Appellant compares his toughness result with respect to the prior art. One of ordinary skill would assume that similar methods were used as those required to obtain the prior art values.

By way of example, if TANG et al. describes a standard, then Appellant can be held to such a standard when comparing claimed results. The claimed values would not require undue experimental procedures on the part of skilled practitioners. The integrity of IBM testing is unquestioned. The Office states that the toughness values are drawn to the composition and not the particle itself and therefore the skilled artisan would not know how to measure the toughness. This statement is blatantly incorrect because the composition whose particles are being measured is a fine powder. The standards for testing toughness are well known in the industry. To suggest that the specification fails for lack of a descriptive testing standard is unfair and harsh.

4. Claims 37, 54, 57, 58, 67, and 68 are objected to under 37 C.F.R. §1.75(c) as having improper dependent form. Claim 37 recites that the epoxy resin of claim 35 is a cycloaliphatic epoxy resin. Appellant respectfully believes that this is a proper limitation upon the subject matter of the previous claim. Appellant similarly does not agree with the Office with respect to claims 54, 57, 58, 67, and 68,

which further limit the substances used in the method of claim 52.

5. Claims 31 to 33, 35, 37, 38, 41, 42, 43, 45, and 46 have been finally rejected over TANG et al. as anticipated under 35 U.S.C. §102(e). Appellant's compositions are uniquely designed for both ceramic and organic substrates. Organic substrates present unique problems that are not a concern with ceramics. The toughness of the composition is specifically improved to provide the ability to withstand the thermal stresses, and the compositions have a coefficient of thermal expansion substantially three times that of the ceramic substrate.

In addition, the claims in question recite a specific environmental and compositional limitation, viz., silica filled flip-chip-attach compositions. The organic substrate poses particular problems for an encapsulant, because they absorb more moisture, are softer, and they bend under thermal stress, as compared with ceramics. The specification and claims recite that the coefficient of thermal expansion (CTE) must be approximately three times that of ceramic materials (i.e., 20 ppm/°C vs. 6.5 ppm/°C). The higher CTE causes a great mismatch between chip and ceramic substrate, requiring that the encapsulant be tougher in withstanding thermal cycling. The inventive compositions increase the required toughness up to fifty percent without excessive change to

viscosity and glass transition temperature, which would be a definite requirement for the substrate that is organic.

Neither TANG et al., HANYU et al., nor USUI et al. realize or solve the problems described by Appellant. They are not concerned with organic substrates. They do not present their compositions in the FCA environment recited in Appellant's preamble to the claims, and they do not recite the method of this invention with respect to claims 52 through 70 (please note the last step of claim 52).

For a rejection to be anticipatory, it is well known case law that the reference should be cognizant of, and express a solution to, the particular problems presented by the application. This is not the case here. The Office attacks the toughness values of Appellant under 35 U.S.C. §112, not because they present any substantial ambiguity, but rather because the references are so woefully silent as to the significant improvement achieved by Appellant.

Claims 34, 36, 39, 40, 41, 43, 44, and 47 through 70 have been rejected under 35 U.S.C. §103(a) as obvious over TANG et al. Please note that TANG et al. uses a cross-linked copolymer for the elastomeric core. TANG et al. is forced to cross-link the core to improve toughness, but this reduces his T_g. This is a direct opposite teaching to Appellant's invention, which maintains toughness without significantly

changing the T_g. Does TANG et al. recite the method of Appellant? Claim 52, for example, recites reflowing the solder joints between the IC chip and the substrate. Where in TANG et al. is this step recited? This step applies to flip-chip-attach techniques. The teachings of TANG et al. are not applicable in this environment.

6. Claim 41 has been rejected under 35 U.S.C. §102(e) as being anticipated by or obvious under 35 U.S.C. §103(a) over USUI et al. Claims 52, 54 through 56, 62, and 64 through 66 have been rejected as unpatentable over USUI et al. The USUI et al. reference is concerned with semiconductors and rubber particles that fail to be uniformly dispersed in the encapsulating resin. This reference presents a totally different environment and concerns different problems and solutions than Appellant's composition and method. The mere fact that USUI et al. teaches a T_g of 70°C or higher is irrelevant. With all due respect, the Office is grasping at straws, bits, and pieces. There is no direct and substantial teaching of the invention in USUI et al. There is no teaching of a silica-filled encapsulant.

7. Claims 42 through 44, and 46 have been rejected under 35 U.S.C. §102(b) as anticipated by HANYU et al. Claims 43, 45, and 47 through 51 have been rejected under 35 U.S.C. §103(a) as being unpatentable over HANYU et al. The Office admits, for example, that the HANYU et al. reference does not

teach the purpose of the invention. Respectfully, this being the situation, it is not proper to include this reference either under 35 U.S.C. §102, or as a sole reference under 35 U.S.C. §103.

CONCLUSION

The Honorable Board is respectfully requested to reverse the rejection of claims 31 through 70 and allow the subject application to issue as a patent.

Respectfully submitted,

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APPENDIX

31. A silica-filled Flip-Chip-Attach (FCA) encapsulant composition for use between an integrated circuit chip and an organic or ceramic substrate, comprising a "core-shell" substance including a fine powder, whose particles each have an outer shell with a glass transition temperature above room temperature and a core with a glass transition temperature below room temperature.

32. The silica-filled FCA encapsulant composition in accordance with claim 31, wherein said substrate comprises a ceramic material, and the encapsulant composition has a coefficient of thermal expansion (CTE) approximately three times that of said ceramic substrate.

33. The silica-filled FCA encapsulant composition in accordance with claim 31, wherein silica fill is in a range of between approximately 40 and 60 percent by weight of the total encapsulant composition.

34. The silica-filled FCA encapsulant composition in accordance with claim 31, including a silane component.

35. The silica-filled FCA encapsulant composition in accordance with claim 31, including at least one epoxy resin material selected from a group of epoxy resin materials

consisting of: polyimides, cyanate esters, and combinations thereof.

36. A silica-filled flip-chip-attach encapsulant composition comprising by weight:

a cycloaliphatic epoxy resin of between approximately 14 and 25 percent;

a methyl-hexahydrophthalic anhydride of between approximately 14 and 25 percent;

at least one aliphatic polyol substance of between approximately 0 and 2 percent;

2-ethyl-4-methylimidazole of less than approximately 1 percent;

a filler powder comprising silica (SiO_2) in a range of between approximately 40 and 60 percent, with a filler particle size being less than approximately 25 microns; and

an epoxy silane of approximately 0.3 and 0.5 percent.

37. The silica-filled FCA encapsulant composition in accordance with claim 35, wherein said epoxy resin comprises a cycloaliphatic epoxy resin in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

38. The silica-filled FCA encapsulant composition in accordance with claim 31, comprising a cycloaliphatic epoxy resin in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

39. The silica-filled FCA encapsulant composition in accordance with claim 31, comprising a cycloaliphatic epoxy resin and a methyl-hexa-hydrophthalic anhydride, each respectively in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

40. The silica-filled FCA encapsulant composition in accordance with claim 39, including a silane component.

41. The silica-filled FCA encapsulant composition in accordance with claim 31, wherein said composition has a toughness of between approximately 800 and 2,500 psi-in$^{1/2}$.

42. A silica-filled flip-chip-attach encapsulant composition for use between an integrated circuit chip and a ceramic or organic substrate, comprising:

a) silica fill in a range of approximately between 40 and 60 percent by weight of the total encapsulant composition; and

b) an epoxy resin and an anhydride, each respectively in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

43. The silica-filled FCA encapsulant composition in accordance with claim 42, wherein said composition has a toughness of between approximately 800 and 2,500 psi-in$^{1/2}$.

44. The silica-filled FCA encapsulant composition in accordance with claim 42, including a silane component.

45. The silica-filled FCA encapsulant composition in accordance with claim 42, wherein said epoxy resin comprises a cycloaliphatic epoxy resin.

46. The silica-filled FCA encapsulant composition in accordance with claim 42, wherein said anhydride comprises a methyl-hexa-hydrophthalic anhydride.

47. A silica-filled flip-chip-attach encapsulant composition for use between an integrated circuit chip and a ceramic or organic substrate, comprising:

a) silica fill in a range of approximately between 40 and 60 percent by weight of the total encapsulant composition; and

b) a cycloaliphatic epoxy resin and a methyl-hexa-hydrophthalic anhydride both respectively in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

48. The silica-filled FCA encapsulant composition in accordance with claim 47, wherein said encapsulant composition has a toughness of approximately between 800 and 2,500 psi-$in^{1/2}$.

49. The silica-filled FCA encapsulant composition in accordance with claim 47, including a silane component.

50. The silica-filled FCA encapsulant composition in accordance with claim 47, including 2-ethyl-4-methylimidazole as a catalyst.

51. The silica-filled FCA encapsulant composition in accordance with claim 47, further comprising a wetting agent.

52. A method of encapsulating an integrated circuit (IC) chip and an organic substrate in order to form a chip carrier, the steps comprising:

applying a silica-filled encapsulant composition to an IC chip and an organic substrate, said composition comprising particles having a core material with a glass transition temperature, T_g, below room temperature and a core-shell material substantially surrounding said core material, said core-shell material having a T_g above room temperature;

curing said encapsulated IC chip and said substrate; and

reflowing solder joints between said IC chip and said substrate.

53. The method of encapsulating an IC chip and an organic substrate in accordance with claim 52, wherein silica fill is in a range of between approximately 40 and 60 percent by weight of the total encapsulant composition.

54. The method of encapsulating an IC chip and a ceramic substrate associated therewith to form a flip-chip-attach (FCA) configuration in accordance with claim 52, wherein said encapsulant composition has a coefficient of thermal expansion (CTE) approximately three times that of said ceramic substrate.

55. The method of encapsulating an IC chip and an organic substrate in accordance with claim 52, including a silane component.

56. The method of encapsulating an IC chip and an organic substrate in accordance with claim 52, including at least one epoxy resin selected from the group of epoxy resins consisting of: polyimides, cyanate esters, and combinations thereof.

57. The method of encapsulating an IC chip and an organic substrate in accordance with claim 55, wherein said epoxy resin comprises a cycloaliphatic epoxy resin.

58. The method of encapsulating an IC chip and an organic substrate in accordance with claim 55, wherein said epoxy resin comprises a cycloaliphatic epoxy resin in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

59. The method of encapsulating an IC chip and an organic substrate in accordance with claim 52, wherein said composition comprises a cycloaliphatic epoxy resin in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

60. The method of encapsulating an IC chip and an organic substrate in accordance with claim 52, comprising a cycloaliphatic epoxy resin and a methyl-hexa-hydrophthalic anhydride, each respectively in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

61. The method of encapsulating an IC chip and an organic substrate in accordance with claim 59, including a silane component.

62. The method of encapsulating an integrated circuit (IC) chip and a ceramic substrate, comprising the steps of:

applying a silica-filled encapsulant composition to an IC chip and a ceramic substrate, said composition comprising particles having a core material with a glass transition temperature, T_g, below room temperature and a core-shell material substantially surrounding said core material, said core-shell material having a T_g above room temperature; and

curing said encapsulated IC chip and substrate.

63. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 60, wherein silica fill is

in a range of between approximately 40 and 60 percent by weight of the total encapsulant composition.

64. The method of encapsulating an IC chip and a ceramic substrate to form a flip-chip-attach (FCA) configuration in accordance with claim 60, wherein said encapsulant composition has a coefficient of thermal expansion (CTE) approximately three times that of said ceramic substrate.

65. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 63, including a silane component.

66. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 60, including at least one epoxy resin selected from the group of epoxy resins consisting of: polyimides, cyanate esters, and combinations thereof.

67. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 65, wherein said epoxy resin comprises a cycloaliphatic epoxy resin.

68. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 65, wherein said epoxy resin comprises a cycloaliphatic epoxy resin in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

69. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 60, wherein said composition comprises a cycloaliphatic epoxy resin in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.

70. The method of encapsulating an IC chip and a ceramic substrate in accordance with claim 60, comprising a cycloaliphatic epoxy resin and a methyl-hexa-hydrophthalic anhydride both respectively in an approximate weight range of between 14 and 25 percent by weight of the total encapsulant composition.